Title: *New Picture of a Magnetic Storm*

Cluster: *Cross-Theme Theory and Data Analysis/SECTP*

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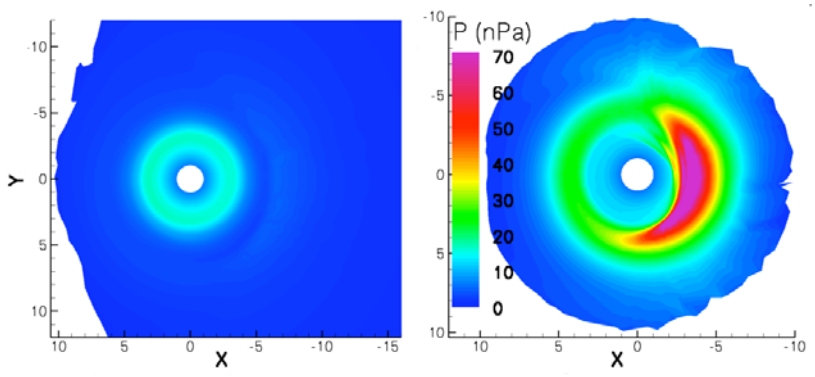
- **Self-Consistent Simulation of a Magnetic Storm Leads to new Picture**

A simulation of an idealized magnetic-storm main phase has been carried out using the Rice Convection Model coupled to a friction-code equilibrium solver. Unlike all previous theoretical simulations of magnetic storms, this one calculates both electric and magnetic fields self-consistently with the charged particle distribution. The new simulation suggests a picture of the storm main phase that differs substantially from conventional wisdom. In the simulation, applying a strong electrical potential drop across the Earth's magnetic tail did not, by itself, produce an electrical ring current or, therefore, a magnetic storm. However, when an additional assumption was added – dramatic non-adiabatic reduction of the specific entropy PV^g in part of the inner plasma sheet – the result was injection of ring-current producing charged particles into the inner magnetosphere. At least two magnetic substorm scenarios imply such reductions of specific entropy, so the simulations provide insight into the physical relationship between substorms and storms.

Development of this new, coupled code, which does a 3D time-dependent simulation of the evolution of the magnetospheric particle distribution that is represented in terms of forty fluids, required years of sustained effort under the SEC Theory Program. The result is an important step forward in understanding magnetic storms and the coupling between the solar wind and the Earth's inner magnetosphere. Such results are needed to interpret and plan spacecraft observations in the inner magnetosphere and ground magnetometer measurements of magnetic storms.



Sun is on left. Axis units are Earth Radii.

Left: equatorial pressure distribution after four hours of strong adiabatic convection.

Right: Asymmetric ring current injection (seen as a dramatic increase in nightside plasma pressure) after five additional hours with reduced specific entropy in the inner plasma sheet.

Lemon, C., R. A. Wolf, et al. (2004), Magnetic storm main phase modeled with full particle drift and self-consistent electric and magnetic fields, *Geophys. Res. Lett.* L21801,doi:1029/2004GL020914.